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CONSPECTUS OF PHYTOCONSTITUENTS AND PHARMACOLOGICAL ACTIVITIES OF *CYPERUS SPP.*: A REVIEW

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ABSTRACT

Cyperaceae are a plant family of grass-like monocots that have a global distribution in temperate and tropical regions. With 950 species, Cyperus is one of the most promising health supplementing genera in the Cyperaceae family. The ability of the nut-grass to adapt to a wide range of soil types, altitudes, temperatures, soil pH, and moisture levels accounts for its widespread distribution. As a result, it can thrive in a variety of habitats and environment**.**Throughout this article, an attempt is made to highlight the phytoconstituents present and the pharmacological activities of Cyperus species. A bibliographic study was conducted by reviewing peer-reviewed papers and consulting widely accepted scientific databases.Cyperus spp. are known to contain a variety of bioactive compounds, such as α-cyperone and α-pinene etc. which give its pharmacological properties. This species' plants have traditionally been used to treat a variety of clinical conditions. They are said to have antioxidant, anti-inflammatory, antimicrobial, and anticancer properties.The information gathered here will play an important role in the development of new drug formulations. Furthermore, detailed structure-activity studies are required to investigate the potential of Cyperus-derived phytochemicals as new pharmaceutical.

Keywords: Cyperus, Bioactivity, Phytoconstituent, Pharmaceuticals, Nut-grass

INTRODUCTION

Herbs have been used as a traditional medicine from the dawn of time. The name "herb" refers to plants that grow in temperate regions, both wild and cultivated, and contain essential oils that can be used in food, medicine, and cosmetics **[1]**. Active compounds derived from medicinal plants are used in the manufacture of many pharmaceuticals **[2]**. According to WHO, traditional medicine is used by 80% of people globally to treat health concerns. According to the World Health Organisation, around 2100 plant species are employed as medicinal plants **[3]**. Natural plants can be exploited to make potent, low-cost, and safe drugs **[4]**.

Herbal medicine is used in all traditional medical practices, including Siddha, Ayurveda, Homoeopathy, Naturopathy, Traditional Chinese Medicine, and Native American Medicine. In both developing and industrialized countries, plant materials are used as over-the-counter medicines, home remedies, and pharmaceutical industry raw materials, making up a significant portion of the worldwide drug market **[5]**.

Cyperus is a grass-like monocot family that contains over 5600 species and 100 genera. Except for Antarctica, it can be found on all continents. With 950 species, Cyperus is the second biggest genus in this family **[6]**. It is a great example of a medicinal plant, with several therapeutic benefits proven by contemporary research and used since ancient times **[7]**. Despite the fact that some civilizations employ Cyperus spp. for medicinal and food purposes, they are typically classified as weeds. These are mostly found in tropical wetlands around the world and provide primary productivity. This plant has a large number of tubers, branches, and fruits that serve as food for amphibians and aquatic creatures **[8]**. Worldwide reports of traditional applications of Cyperus plants as a treatment for a range of human diseases have been made **[9]**.

Plant extracts are also used to treat bronchitis, blood problems, irregular menstruation, amenorrhea, diarrhoea, dysentery, and inflammatory conditions **[10]**. Despite the fact that there are over 950 species in the genus Cyperus, the four species that are most commonly mentioned are purple nutsedge (*Cyperus rotundus* L.), rice flatsedge (*Cyperus iria*), yellow nutsedge (*Cyperus esculentus* L.), and *C. papyrus*. The Cyperus species is popular in South Asia is Cyperus rotundus, a perennial that develops on moist soil and spreads readily via rhizomes and tubers **[11]**. In countries of Asia, the use of *C. rotundus* rhizomes as traditional folk remedies for treating bowel as well as stomach problems has received extensive study, as well as inflammatory conditions **[12]**. It's also

commonly used to treat analgesia, drowsiness, antispasmodic, antimalarial, stomach problems, and diarrhoea **[13]**. One of the earliest recognized medicinal plants is the tuber, having been used to treat dysmenorrhea and monthly irregularities for thousands of years **[14-15]**. It is a multipurpose plant that is utilized for long-time traditional medication to cure stomach issues, wounds, boils, and blisters **[16-19, 59]**. A variety of biological as well aspharmacological effects have been demonstrated, including antioxidant, antibacterial, antifungal, antidiabetic, and anticancer characteristics.

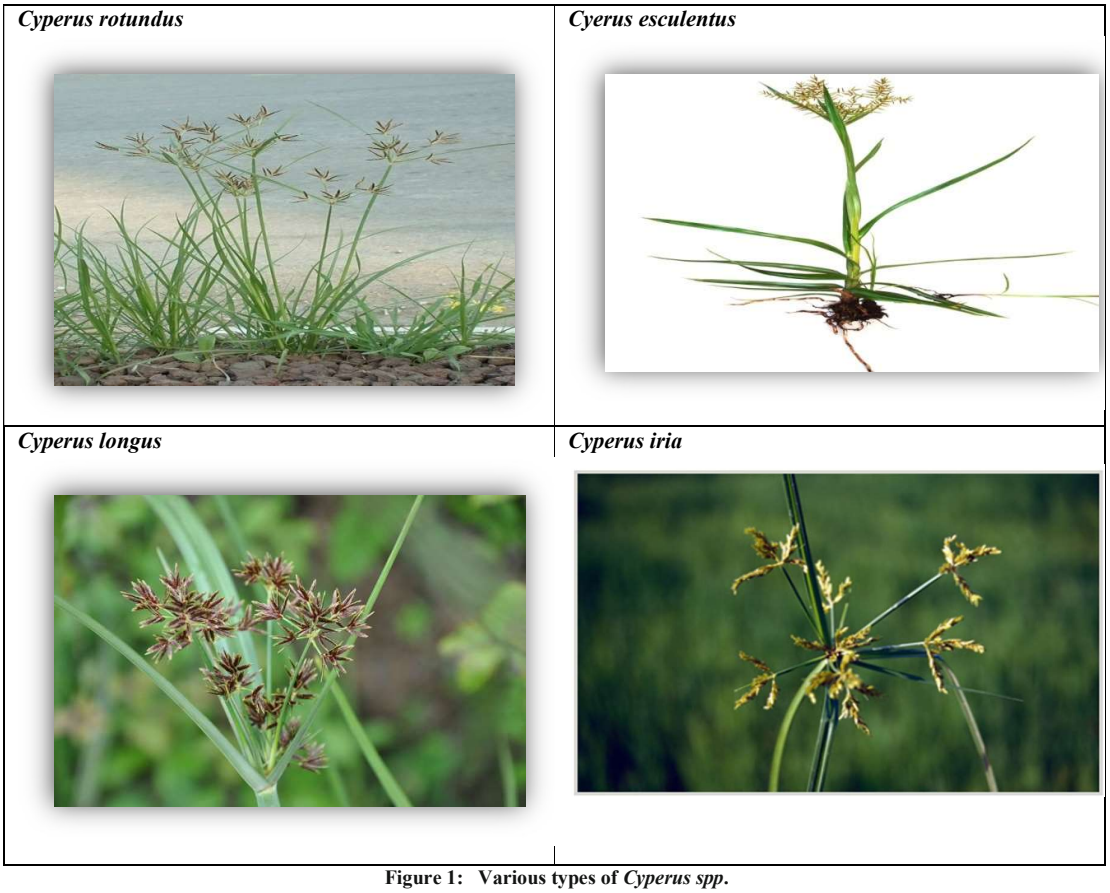


Figure 1: Various types of *Cyperus spp*.

Taxonomy of *Cyperus rotundus*:

Kingdom:"Plantae

Phylum: Tracheophyta

Class: Liliopsida

Order: Poales

Family: Cyperaceae

Genus: Cyperus

Species:*Cyperus rotundus*

Taxonomy of *Cyperus esculentus*:

Kingdom: Plantae

Phylum: Tracheophyta

Class: Magnoiopsida

Order: Poales

Family: Cyperaceae

Genus: Cyperus

Species:*Cyperus esculentus*

Taxonomy of *Cyperus longus*:

Kingdom: Plantae

Phylum: Tracheophyta

Class: Liliopsida

Order: Poales

Family: Cyperaceae

Genus: Cyperus

Species:*Cyperus longus*

Taxonomy of *Cyperus iria*:

Kingdom: Plantae

Phylum: Spermatophyta

Class: Monocotyledonae

Order: Cyperales

Family: Cyperaceae

Genus: Cyperus

Species:*Cyperus"iria*

2. Phytoconstituents & chemical composition

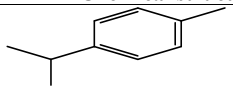
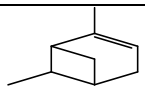
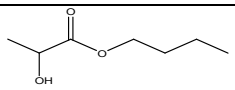
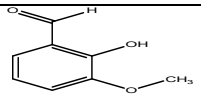
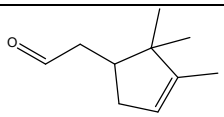
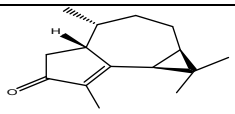
Previous phytochemical studies on Cyperus spp. found flavonoids, Alkaloids, starch, tannins, furochromones, glycosides, sesquiterpenes, monoterpenes, fatty oil with a waxy, neutral substance, sitosterol, glycerol, myristic, linolenic, and stearic acids **[20-21]**. The primary chemicals identified from C.rotundus rhizome extracts as well asessential oil are alpha-rotunol, alpha-cyperone, beta-pinene, beta-cyperone, beta-selinene, beta-rotunol, camphene, copaene, calcium, cyperenone, cyperene, cyperolone, and cyperol.Others include Cyperotundone D-fructose, D-glucose, D-copadiene, and D-epoxyguaiene. Isokobusone, Isocyperol, Limonene, Kobusone, Flavonoids Gamma-cymene Magnesium, Manganese, Linoleic Acid, Linolenic Acid Rotunduskone, C. P-cymol, Patchoulenone, Pectin, Myristic acid, Oleanolic acid, Oleanolic acid-3-o-neohesperidoside, Oleic acid, C. P-cymol, Patchoulenone, Pectin, Myristic acid, Oleanolic acid-3-o-n Patchoulenone, P-cymol, Pectin Polyphenols **[22-24]** discovered in Cyperus species include Rotundenol, Rotundene, Selinatriene, Rotundone, Sitosterol, Stearic-acid, Sugeonol, and Sugetriol. The *C. rotundus* essential oil, which gives the plant its particular flavor and scent, is mostly made up of sesquiterpene hydrocarbons, ketones, epoxides, aliphatic alcohols, and monoterpenes. Sesquiterpenes found in the plant species involve isocurcumenol, selinene, aristolone, nootkatone, isorotundene, norrotundene, and cypera-2,4(15)-diene. There is also cyperadione, a ketone, and the limonene, camphene, andmonoterpenes cineole. C.rotundus also includes flavonoids, carbohydrates, and minerals, as well as triterpenes such as oleanolic acid and sitosterol.

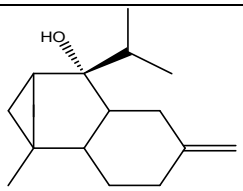
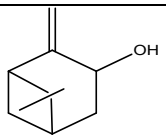
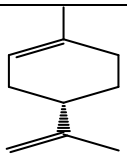
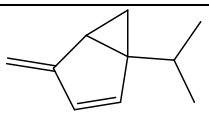
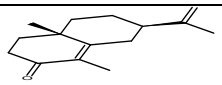
4 chemotypes (K-, H-, and M-O-types) of Asian essential oils have been identified based on extensive study on the *C. rotundus* essential oil chemical composition.The

Japanese H-type was 36.6 percent a-cyperone, 18.5% ß-selinene, 7.4% cyperol, and 6.2% caryophyllene. 30.7% a-cyperone, 19.4% cyperotundone, 17.8% ß-selinene, 7.2% cyperene, and 5.6% cyperol were found in M-type from China, Japan, Hong Kong, Vietnam, and Taiwan. cyperotundone (13.1%), Cyperene (30.8%), and ß-elemene (5.2 percent) were the main components that distinguished the O-type from samples from Taiwan, Japan, Philippines, Hawaii, and the Thailand. Furthermore, cyperotundone (25.0%) and cyperene (20.7%) were the most abundant chemicals in Hawaiian O-type. The K-type, on the other hand, was dominated by cyperotundone (8.8%), cyperene (287.7%), sugeonyl acetate (6.9 percent), and patchoulenyl acetate (8.0%) **[25-31]**.

I. Phytoconstituent present in various species of *cyperus* (Table 1)

Table 1:Phytoconstituents of *Cyperus species*

S. No.	Chemical constituent	Chemical structure
1	**α –cymene**	
2	**α-pinene**	
3	**Isobutyl lactate**	
4	**Vanillin**	
5	**α –campholenal**	
6	**Cyclocolorenone**	

7	**β-copaen-4-α-ol**	
8	**Trans-pinocarveol**	
9	**Limonene**	
10	**Thuja-2,4(10)-diene**	
11	**α-cyperone**	

II.Traditional uses of various species of *cyperus* (Table 2)

Table 2: Traditional uses of cyperus species

Plant species	Parts	Traditional uses
Cyperus rotundus L.	Whole plants	Epilepsy,Menstruation problems,Bone fracture
	Tubers	Dermatitis,Dysentry,Indigestion, Diabetes
	Roots/Tubers	Urinary trouble-stoneremoval
	Roots	Cholera,Increaselactation, Intermittent fevers
Cyperus javanicus Houtt.	Leaves	Fractures/sprains,Irregular menstrual
Cyperus brevifolius (Rottb.) Hassk.	Tubers	Sore legs
Cyperus monocephalus Roxb.	Tubers	Ringworm
Cyperus articulates L.	Tubers	Headache, migraine
Cyperus compressus L.	Roots	Helminthiasis
Cyperus pedunculatus	leaves and Stem	Disease ofthe kidney, Diarrhea, pain, fever,and inflammations
Cyperus sexangularis Nees	Roots	Antimicrobial, diuretic, emollient,anthelmintic, analgesic therapy,and stimulant
Cyperus iria	Roots	Antimicrobial, Antifungal activity

III.Pharmacological activity (Figure 2)

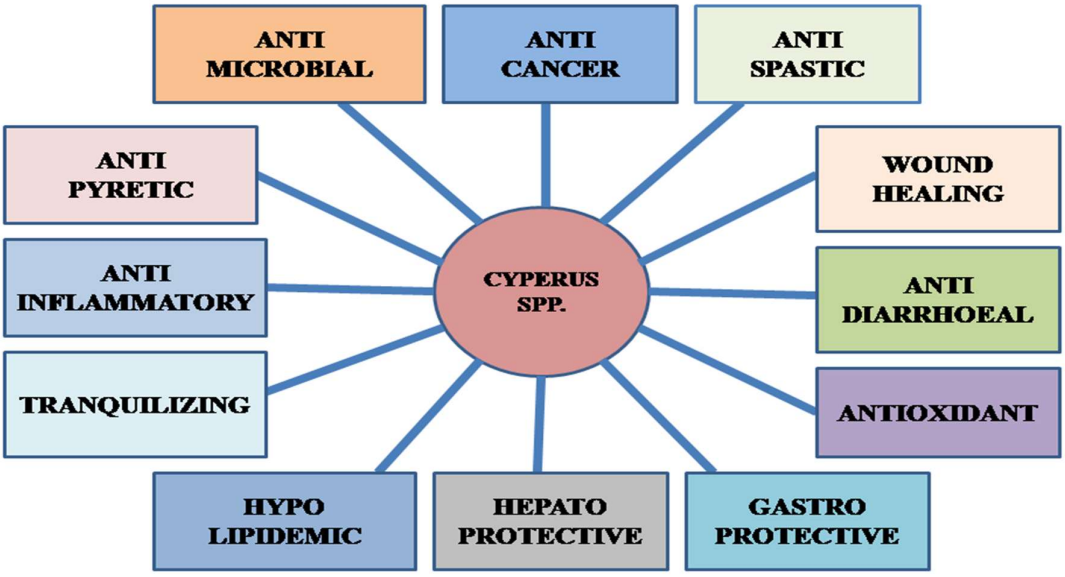


Figure 2: Pharmacological activities of *Cyperus spp.*

1.Anti-Inflammatory Activity:

Numerous investigations have demonstrated that extracts derived by different plant components of the Cyperus genus have substantial anti-inflammatory effects **[32]**. *C. rotundus* rhizome extract's anti-inflammatory action was originally published in 1971 **[33]**, and ever since,studies were undertaken to validate and comprehend the anti-inflammatory impact on various components of plants or active elements of *C. rotundus* . Cyperone, The key phytochemicals contained in *C. rotundus* oil, has been revealed to block LPS-stimulated Akt (protein kinase B) activation, It causes a murine BV-2 microglial cell line to become inflammatory.Factor-E2-relates to factor (Nrf)-2/heme oxygenase-1 prevents nuclear factor kappa light chain activator of the activated B cell (NF-B) pathway from functioning (HO-) **[34]**. According to the research, -cyperone affects BV-2 cells in a neuroprotective manner by increasing the Akt/Nrf2/HO-1 pathway and lowering the NF-B pathway.

Additional research found that an alcoholic extract of *C. rotundus* significantly (P0.001) alleviated inflammation in two animal models of inflammation (Rats with formaldehyde- and carrageenan-induced arthritis). It outperformed hydrocortisone in terms of anti-inflammatory activities (carrageenan-induced oedema model,

75.9% versus 47.3%); 55.1% versus 35.6% in the model of formaldehyde-induced arthritis **[35-38]**).

2.Antipyretic Activity:

Brewer's yeast in gum acacia in ordinary saline solution when dried was subcutaneously delivered into albino rats, pyrexia was generated. Against this pyrexia, the *C .rotundus* alcoholic extract demonstrated a very relevant (P0.001) antipyretic activities.A specific fraction made using a chromatographic technique from the petroleum ether extract was employed in the same animal model and shown to have substantial anti-pyretic impacts is same as acetyl salicylic acid **[39]**.

3.Antimicrobial Activity:

Numerous investigations have shown that *C. rotundus* extract has antibacterial activity **[40-44]**. It has been shown that Gram-positive bacteria respond to Cyperus extracts more favourably than Gram-negative bacteria.The many different microbiological tests,species and microbial genera, existence of saccharides, conditions for herb growth, extraction processes, and other factors, direct comparison of various studies proved difficult **[45]** . For instance, research using the *C.articulatus* essential oils found amazing inhibitory impacts on *Escherichia coli* as well as *Staphylococcus aureus* **[46]**. Research has demonstrated that plant alcohol extracts are substantially more strong and effective than water, despite the fact that traditional medicine practitioners often utilized water like a solvent **[47]**. Aqueous and alcohol extracts of *C. rotundus* tubers that included essential oils were examined to see how they affected *Aggregatibacteras* well as *Streptococcus mutans* cultures, *Candida albicans*, and *actinomycete mcomitans*. Alcoholic extracts suppressed the growth of A. actinomycetemcomitansas well asS. mutans, made the candidates potential for periodontitis and oral cavity diseases therapy and prevention **[48]**.

Another research looked at the toxicity of giving mice C. conglomerates chloroform extracts orally. *Candida dubliniensis, Candida albicans, Candida glabrata, Candida inconspicua,and Candida famataall* grew more slowly. The most frequently occurring required to establish had a significant impact in the development of *C. albicans* as well asC. Famata **[49]**.

4. Tranquilizing activity:

In several experiments, the ethanolic extract of *C. rotundus* demonstrated a significant tranquillizing effect. It reduced mice's conditioned avoidance response, increased pentobarbital narcosis, disturbed motor coordination, and hindered spontaneous motor activity **[50]**.

5.Anticancer Activity:

The anticancer potential of *C. rotundus* extracts was investigated, along with action mode and impact on gene expression. When

treated to various concentrations of *C. rotundus* extracts, HeLa cell lines from human cervical cancer showed differences in the amount of chromatin condensation as well as morphological alterations. The extract boosted the expression of 449 genes while reducing the expression of 484 genes, which were categorised as distinct interaction networks, associated cell cycle arrest, and apoptosis-related gene expression induction **[51]**. Plant extracts' anticancer effects are largely attained by decreasing malignant cells' ability to multiply or by inducing apoptosis in these cells. The two of these systems are disrupted in malignant cells. The anticancer potential of *C. rotundus* extracts were investigated, along with the action mode and impact on gene expression. When treated to various concentrations of *C. rotundus* extracts, HeLa cell lines from human cervical cancer showed differences in the amount of chromatin condensation as well as morphological alterations. The extract boosted the expression of 449 genes while reducing the expression of 484 genes, which were categorized as distinct interaction networks, associated cell cycle arrest, and apoptosis-related gene expression induction **[51]**. Plant extracts' anticancer effects are largely attained by decreasing malignant cells' ability to multiply or by inducing apoptosis in these cells. The two of these systems are disrupted in malignant cells.The effects of *C. rotundus* ethanol extracts on TNBC (Triple-Negative Breast Cancer Cells) were investigated **[52]**. TNBCs are cells that do not upregulates the oestrogen, progesterone, or HER2 (Human Epidermal Growth Factor Receptor 2) proteins.

Benzoquinones isolated by the *Cyperus sp.* tubers as well as roots have been tested for their cytotoxic effects on gastric cells lines of human lines and adenocarcinoma gastrica (AGS). The endoplasmic reticulum was claimed to be stressed by benzoquinones, which also enhanced the production of C/EBP homologous protein (protein as well as mRNA levels), altered calcium dynamics, intracellular ROS, and caspase-4 activation. The inositol-requiring enzyme 1 (IRE1-) independent/(PKR-like ER kinase) PERK-dependent pathway was employed in the first investigation to characterise the proteasome inhibition induced by hydroxyl cyperaquinone in stomach cancer cells (inducing cell death).Recently, the anticancer potential of silver nano-particles in conjunction with extracts of *C. conglomeratus* was examined **[53]**.

6.Hepatoprotective Activity:

By causing liver injury with carbon tetrachloride, ethyl acetate extract, and two crude fractions of *C. rotundus* (Cyperaceae) rhizomes, ethyl acetate as well as solvent ether, were investigated for hepatoprotective efficacy in rats. Lower blood levels of glutamic pyruvic transaminase,total

bilirubin,alkaline phosphatase, and glutamic oxaloacetic transaminase have been seen after oral administration of an ethyl acetate extract with dosage of 100mg/kg. A strong protective effect was seen as a result. Histopathological analysis of liver slices supported these biochemical data. The medication silymarin served as a positive control **[54]**.

7.Gastroprotective Activity:

C.rotundus extract protected rats' stomach mucosa from reperfusion as well as ischemia injury. The rat ulcer index given 100and 200mg/kg *C. rotundus* was considerably lower than in controls. The treatment with *C. rotundus* had a substantial influence on glutathione-peroxidase and malondialdehyde activities. In rats with ethanol-induced stomach injury, C.rotundus has also been demonstrated to exhibit cytoprotective properties. Rhizoma Cyperidecoctions administered orally to rats (30 minutes before ethanol) demonstrated a dose-dependent ulcer-inhibiting effect (1.25, 2.5, 4.0 g crude drug/kg). Pretreatment with indomethacin (5 mg/kg) considerably inhibited *C. rotundus* 's stomach protective effect **[55]**.

8.Antispastic Activity:

C. rotundus ethanolic extract increased ileum relaxation and spasmolysis in response to 5-hydroxitriptamine, barium chloride, and acetylcholine -induced contractions, indicating that there is a direct relaxant effect on smooth muscle **[56]**.

9.Antidiarrhoeal Activity:

Rats with castor oil-induced diarrhoea responded significantly to oral dosages of 250 and 500 mg/kg of a methanol extract of the *C. rotundus* rhizome.When evaluated at 250mg/kg, both the residual methanol as well aspetroleum ether fractions maintained activities, with the residual methanol fraction is more active in comparison to control. The fraction of ethyl acetate showed no antidiarrheal effect **[57]**.

10.Hypolipidaemic Activity:

During the study, Wistar rats weighing between 250 and 300g were utilized. Seven groups of six rats each were formed out of the rats. Group 1 Rats received a regular pellet meal and a vehicle control of a 0.1 percent sodium CMC solution. For the duration of the 25-day experiment, the six additional rat groups were given a high-fat diet. One of the most typical methods to produce hyperlipidaemia is through a high-fat diet. As a result, the oral administration of a diet high in fat resulted in hyperlipidaemia. A diet high in fat included high-calorie, 1% cholesterol-enriched chow. Group 2 of rats was kept untreated after 10 days of hyperlipidaemia development it acted as the control for the high-fat diet. For 15 days, the remaining groups received the following treatment. Groups 3 and 4 received dosage orally of fenofibrate

(20mg/kg/day) and simvastatin (5mg/kg/day). Groups 5, 6, and 7 received oral dosages of aqueous extract at 100mg/kg/day, 200mg/kg/day, and 400mg/kg/day, respectively. Every drug was suspended at 0.1 percent Na CMC (vehicle). After an overnight fast, blood was drawn from the retro-orbital plexus. Blood was drawn, the serum centrifuged at 3000 rpm for ten minutes, and then analysed using commercially available kits for total cholesterol, triglycerides, and HDL cholesterol (Erba Diagnostics Germany). The Friedwald formula was used to determine serum LDL **[58]**.

11.Wound healing Activity

Excision, incision,and dead space are the models of wound on rats have been utilized investigate the wound healing abilities of an alcoholic extract of *C. rotundus* tuber parts.In all of the abovementioned wound models, the extract ointments exceeded a traditional medication nitrofurazone ointment (0.2%w/w NFZ) considerably in respect of wound contracting capability, time for wound clousre, and Tensile power **[59]**.

12.Antioxidant Activity

Spices (*Zingiber officinale, Piper nigrum,* and *Piper longum*), herbs (*Plumbago zeylanica* and *Cyperus rotundus* Linn.), and salts that combine Amrita Bindu were evaluated for its antioxidant activities.The researchers wanted to see how individual Amrita Bindu constituents reacted to the free radical 2,2'-azinobis-(3-ethylbenzothiazoline-6sulphonicacid) (ABTS). *Piper nigrum*> Piper longum> *Cyperus rotundus*> *Plumbago zeylanca*> *Zingiber officinale* have been determined to have the highest antioxidant potential. A salt-spice-herbal combination called Amrita Bindu that contains *C. rotundus* Linn, has strong antioxidant capability opposed to oxidative damage brought on by free radicals, in view of these conclusions **[60]**.

CONCLUSION:

Due to its extensive range of pharmacological qualities, that involves anti-inflammatory, antioxidant,anti-cancer, hepatoprotective, and other capabilities, Cyperus sp. is often utilized as a powerful ethnomedicine in many traditional medicinal systems. Structure-activity investigations of the discovered phytoconstituents also provided perspectives of the underlying molecular mechanisms behind the effects of its phytochemicals as well as active extracts.However, there is inconclusive evidence to support its broad pharmacological characteristics and widespread usage in traditional medicine. Although Cyperus spp's phytochemicals have been found, thorough studies on the pharmacological effects isolated compounds using animal models absent. Given the wide-ranging pharmacological Cyperus spp,

a potential more thorough study is necessary to comprehend its mode of action.

Conflict of interest:

All authors declare that they have no conflict of interest.

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REFERENCE:

[1] Peter KV, Bab KN, Introduction to herbs and spices: medicinal uses and sustainable production, In Handbook of herbs and spices Woodhead Publishing.

[2] Rasool BA, Medicinal plants (importance and uses), Pharmaceutica Analytica Acta, 2012; 3(10):2153-435.

[3] Reelsaltlife.blogspot.in/2012/02/role-of-herbs-in-human-life.html.

[4] Kokate CK, Gokhale SB. Textbook of Pharmacognosy. Nirali Prakashan, New Delhi. 2007.

[5] Govaerts R, Simpson DA, World checklist of Cyperaceae, Kew Pub Royal Botanic Gardens;2007.

[6] Larridon I, Villaverde T, Zuntini AR, *et al*., Tackling rapid radiations with targeted sequencing,Frontiers in plant science ,2020;10:1655.

[7] Sivapalan SR, Medicinal uses and pharmacological activities of *Cyperus rotundus* Linn-A Review, International Journal of Scientific and Research Publications,2013; 3(5): 1-8.

[8] Dwyer J, *Cyperus rotundus* L.: An ancient food staple but now designated the world's worst weed, In Proceedings of 20 th Australasian Weeds Conference, 2016; 251-254.

[9] Reznicek A, Kearns D, Simpson D, Tucker G, Camelbeke K, González-Elizondo M, Strong M, Goetghebeur P, Kral R, Thomas W. Cyperaceae. Encyclopedia Britannica;2008.

[10] Udari LM. Medicinal properties of Cyperus species (sedge family, Cyperaceae). Eastern Illinois University;2018.

[11] Peerzada AM, Ali HH, Naeem M, Latif M, Bukhari AH, Tanveer, *Cyperus rotundus* L.: Traditional uses, phytochemistry, and pharmacological activities, Journal of ethnopharmacology, 2015; 174: 540-560.

[12] Gupta MB, Palit TK, Singh N, Bhargava KP, Pharmacological studies to isolate the active constituents from *Cyperus rotundus* possessing anti-inflammatory, anti-pyretic and analgesic activities, The Indian journal of medical research,1971; 59(1): 76-82.

[13] Zhu M, Luk HH, Fung HS, Luk CT, Cytoprotective effects of

Cyperus rotundus against ethanol induced gastric ulceration in rats, Phytotherapy Research, 1997; 11(5): 392-394.

[14] Yu J, Lei G, Cai L, Zou Y, Chemical composition of *C. rotundus* extract, Journal of Phytochemistry, 2004 ;65:881-889.

[15] Hussain HAAK, Extraction, Identification and Antibacterial activity of Cyperus oil from Iraqi *C. rotundus* , Engineering and Technology Journal, 2008; 26(10): 1156-1163.

[16] Oliver-Bever BEP.Medicinal plants in tropical West Africa. Cambridge university press;1986.

[17] Puratchikody A, Devi CN, Nagalakshmi G, Wound healing activity of *Cyperus rotundus* linn, Indian journal of pharmaceutical sciences, 2006; 68(1):97.

[18] Joshi AR, Joshi K, Indigenous knowledge and uses of medicinal plants by local communities of the Kali Gandaki Watershed Area, Nepal, Journal of Ethnopharmacology, 2000; 73(1-2): 175-183.

[19] El-Kamali HH ,El-Khalifa KF, Folk medicinal plants of riverside forests of the Southern Blue Nile district, Sudan, Fitoterapia, 1999 ; 70(5): 493-497.

[20] Dutta SC, Mukerji B, Douglas CH, Pharmacognosy of Indian root and rhizome drug, Manager of Publications, Delhi, 1949.

[21] Khan S, Choi RJ, Lee DU, Kim YS, Sesquiterpene derivatives isolated from *Cyperus rotundus* L. Inhibit inflammatory signaling mediated by NF-${\kappa} B$, Natural Product Sciences, 2011; 17(3): 250-255.

[22] Lawal OA, Oyedeji AO, Chemical composition of the essential oils of *Cyperus rotundus* L. from South Africa, Molecules, 2009; 14(8): 2909-2917.

[23] Sonwa MM, König WA, Chemical study of the essential oil of *Cyperus rotundus*, Phytochemistry, 2001; 58(5): 799-810.

[24] Jeong SJ, Miyamoto T, Inagaki M, Kim YC, Higuchi R, Rotundines A− C, Three novel sesquiterpene alkaloids from *Cyperus rotundus* , Journal of Natural Products., 2000; 63(5): 673-675.

[25] Kilani S, Ledauphin J, Bouhlel I *et al*., Comparative study of *Cyperus rotundus* essential oil by a modified GC/MS analysis method. Evaluation of its antioxidant, cytotoxic, and apoptotic effects, Chemistry & Biodiversity,2008; 5(5):729-742.

[26] Komai K,Tang CS, A chemotype of *Cyperus rotundus* in Hawaii, Phytochemistry,1989; 28(7):1883-1886.

[27] Komai K, Shimizu M, Tang CS, Tsutsui H, Sesquiterpenoids of *Cyperus bulbosus*, *Cyperus tuberosus* and *Cyperus rotundus* , Memoirs of the Faculty of Agriculture of Kinki University (Japan) ,1994;27:39-47.

[28] Ekundayo O, Oderinde R, Ogundeyin M, Stahl-Biskup E, Essential oil constituents of *Cyperus tuberosus* Rottb. Rhizomes, Flavour and fragrance journal,1991; 6(4):261-264.

[29] Kilani S, Abdelwahed A, Ammar RB *et al*., Chemical composition, antibacterial and antimutagenic activities of essential oil from (Tunisian) *Cyperus rotundus*, Journal of Essential Oil Research, 2005; 17(6): 695-700.

[30] Zoghbi MDG, Andrade EH, Carreira LM, Rocha EA, Comparison of the main components of the essential oils of "priprioca": *Cyperus articulatus* var. *articulatus* L., C. articulatus var. nodosus L., C. prolixusKunth and *C. rotundus* L, Journal of Essential Oil Research, 2008; 20(1): 42-45.

[31] Jirovetz L, Wobus A, Buchbauer G, Shafi MP, Thampi PT, Comparative analysis of the essential oil and SPME-headspace aroma compounds of *Cyperus rotundus* L. roots/tubers from South-India using GC, GC-MS and olfactometry, Journal of Essential Oil Bearing Plants,2004; 7(2):100-106.

[32] Al-Snafi AE,A review on *Cyperus rotundus* A potential medicinal plant,IOSR Journal Of Pharmacy ,2016; 6(7):32-48.

[33] Gupta MB, Palit TK, Singh, N, Bhargava KP,Pharmacological studies to isolate the active constituents from *Cyperus rotundus* possessing anti-inflammatory, anti-pyretic and analgesic activities, The Indian journal of medical research,1971; 59(1):76-82.

[34] Huang B, He D, Chen G,α-Cyperone inhibits LPS-induced inflammation in BV-2 cells through activation of Akt/Nrf2/HO-1 and suppression of the NF-κB pathway, Food & function,2018;9(5):2735-2743.

[35] Kapadia VH, Naik VG, Wadia MS, Dev S, Sesquiterpenoids from the essential oil of *Cyperus rotundus*,

Tetrahedron Letters, 1967; 8(47): 4661-4667.

[36] Singh N, Kulshrestha VK, Gupta MB, Bhargava KP,A pharmacological study of *Cyperus rotundus*, The Indian journal of medical research, 1970; 58(1):103-109.

[37] Singh N, Kulshrestha VK, Gupta MB, Bhargava KP, Pharmacological studies on *Cyperus rotundus* . Indian Journal of Pharmaceutical Science, 1967;1(2):9.

[38] Singh N, Gilca M, Herbal Medicine: Science Embraces Tradition: a New Insight Into Ancient Ayurveda.,Lambert Academic Pub,2010;139-148.

[39] Gupta MB, Palit TK, Singh N, Bhargava KP, Pharmacological studies to isolate the active constituents from *Cyperus rotundus* possessing anti-inflammatory, anti-pyretic and analgesic activities, The Indian journal of medical research ,1971;59(1): 76-82.

[40] Khojaste M, Yazdanian M, Tahmasebi E, Shokri M, Houshmand B, Shahbazi R,Cell toxicity and inhibitory effects of *Cyperus rotundus* extract on *Streptococcus mutans*, *Aggregatibacter actinomycetem comitans* and *Candida albicans*, European journal of translational mycology, 2018;28(4):366-367.

[41] Al-Hazmi GH, Awaad AS, Alothman MR, Alqasoumi SI, Anticandidal activity of the extract and compounds isolated from *Cyperus conglomertus* Rottb. Saudi Pharmaceutical Journal, 2018; 26(6): 891-895.

[42] Sharma SK, Singh AP, Morphological, microscopical and physico-chemical investigations on the rhizomes of *Cyperus rotundus* Linn., Research journal of pharmaceutical, biological and chemical sciences, 2011; 2(3):798-806.

[43] Prasad MP. Analysis of antimicrobial compounds in *Cyperus rotundus* and *Azadirachta indica* against human pathogens, International Journal of Current Microbiology and Applied Sciences,2014; 3(3):206-210.

[44] Kabbashi AS, Mohammed SEA, Almagboul AZ, Ahmed IF, Antimicrobial activity and cytotoxicity of ethanolic extract of *Cyperus rotundus* L., American Journal of Pharmacy and Pharmaceutical Sciences,2015; 2(1):1-13.

[45] Haghgoo R, Mehran M, Zadeh HF, Afshari E, Zadeh NF, Comparison between antibacterial effect of chlorhexidine 0.2% and different concentrations of *Cyperus rotundus* extract: An in vitro study, Journal of International Society of Preventive & Community Dentistry ,2017; 7(5):242.

[46] Kavaz D, Idris M, Onyebuchi C, Physiochemical characterization, antioxidative, anticancer cells proliferation and food pathogens antibacterial activity of chitosan nanoparticles loaded with *Cyperus articulatus* rhizome essential oils, International journal of biological macromolecules, 2019;

[47] de Boer HJ, Kool A, Broberg A, Mziray WR, Hedberg I, Levenfors J.J, Anti-fungal and anti-bacterial activity of some herbal remedies from Tanzania. Journal of ethnopharmacology, 2015; 96(3): 461-469.

[48] Khojaste M, Yazdanian M, Tahmasebi E, Shokri M, Houshmand B, Shahbazi R,Cell toxicity and inhibitory effects of *Cyperus rotundus* extract on *Streptococcus mutans*, Aggregatibacteractinomycetemco mitans and Candida albicans, European journal of translational mycology, 2018; 28(4): 363-364.

[49] Al-Hazmi GH, Awaad AS, Alothman MR, Alqasoumi SI, Anticandidal activity of the extract and compounds isolated from CyperusconglomertusRottb. Saudi Pharmaceutical Journal,2018; 26(6):891-895.

[50] Singh N, Kulshrestha VK, Gupta MB, Bhargava, KP, A pharmacological study of *Cyperus rotundus* . The Indian journal of medical research,1970 ; 58(1):103-109.

[51] Lin CH, Peng SF, Chueh FS, Cheng ZY, Kuo CL, Chung JG, The ethanol crude extraction of *Cyperus rotundus* regulates apoptosis-associated gene expression in HeLa human cervical carcinoma cells in vitro, Anticancer research,2019;39(7):3697-3709.

[52] Simorangkir D, Masfria M, Harahap U, Satria D, Activity anticancer n-hexane fraction of *Cyperus rotundus* L. Rhizome to breast cancer MCF-7 cell line, Open Access Macedonian Journal of Medical Sciences **ed. Sci**.2019; 7(22):3904.

[53] Ribeiro V, Andrade PB, Valentão P, Pereira DM, Benzoquinones from Cyperus spp. trigger IRE1α-

independent and PERK-dependent ER stress in human stomach cancer cells and are novel proteasome inhibitors, Phytomedicine,2019; 63:153017.

[54] Kumar SS, Mishra SH, Hepatoprotective activity of rhizomes of *Cyperus rotundus* Linn against carbon tetrachloride-induced hepatotoxicity**,** Indian journal of pharmaceutical sciences,2005; 67(1):84.

[55] Zhu M, Luk HH, Fung HS, Luk CT, Cytoprotective effects of *Cyperus rotundus* against ethanol induced gastric ulceration in rats, Phytotherapy Research, 1997;11(5):392-394.

[56] Singh N, Kulshrestha VK, Gupta MB, Bhargava KP, A pharmacological study of *Cyperus rotundus* , The Indian journal of medical research,1970; 58(1):103-109.

[57] Uddin SJ, Mondal K, Shilpi JA, Rahman MT. Antidiarrhoeal activity of *Cyperus rotundus* , Fitoterapia, 2006 ; 77(2):134-136.

[58] Friedewald WT, Levy RI, Fredrickson DS, Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge, Clinical chemistry, 1972;18(6):499-502.

[59] Natarajan B, Paulsen BS, An ethnopharmacological study from Thane district, Maharashtra, India: Traditional knowledge compared with modern biological science, Pharmaceutical Biology, 2000; 38: 139–151.

[60] Taheri W, Bravo JH, Huala L, Cyperus spp.: A Review on Phytochemical Composition, Biological Activity, and Health-Promoting Effects, Oxidative Medicine and Cellular Longevity, 2021; 2021:1-17.